



# Commonwealth of Massachusetts

## Executive Office of Labor and Workforce Development

### Breakfast Safety Seminar

September 17 & 24, 2010

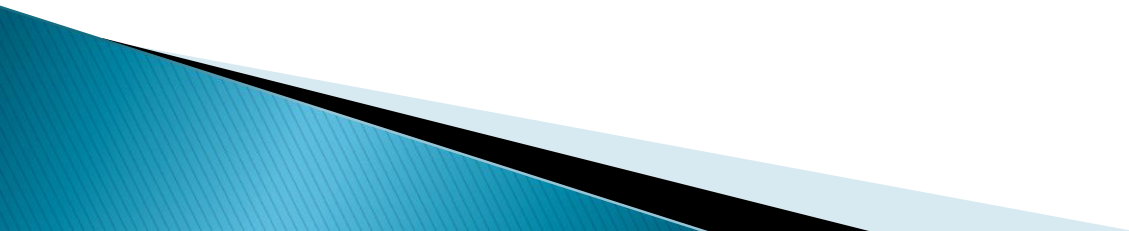
## Hazards of Lead Complying with OSHA, EPA and State

Deval L. Patrick, Governor  
Timothy P. Murray, Lieutenant Governor

Joanne Goldstein, Secretary

George Noel, Director  
Heather Rowe, Acting Commissioner

# Health Hazards in Lead



# Lead

## ► What is it?

**Lead** is a naturally occurring metal, but you can't find it in nature in its pure form. Instead, you have to smelt it from an ore, the most common of which is galena. It is a heavy metal that is both soft and dense.

Lead

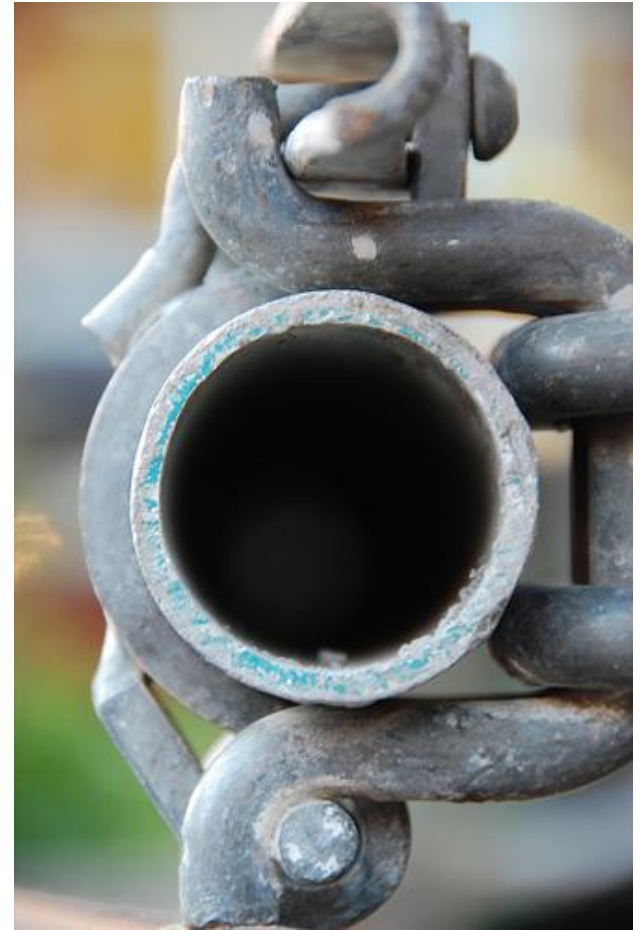


► **Where is it found?**

The base for old paint, shields that protects you during X-rays, used in pewter and pipes, batteries and buckshot, gasoline and glazes, sound dampeners and solder.

**It shouldn't be in our bodies.**

**The human body has absolutely no need or use for Lead.**



Lead pipe

# Lead

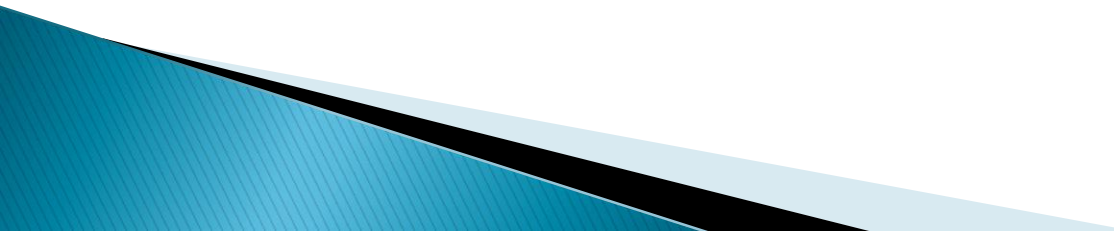
- ▶ A house painter affected by chronic Lead poisoning. Wasted muscles and wrist drop are tell-tale symptoms of Lead poisoning.



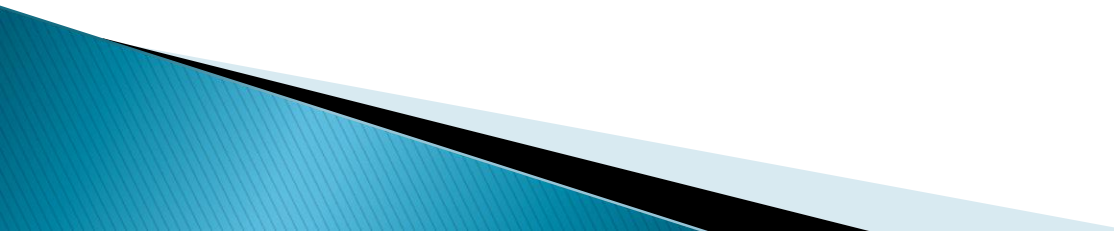
# Why is Lead dangerous?

- ▶ It can seriously injure:
  - Brain
  - Nervous system
  - Red blood cells
  - Reproductive systems of women and men
  - Kidneys
- ▶ **Heavy metal:** stored in bone marrow, nerve tissues (brain) and kidneys: Excrete small amounts in urine and stool but could take years to return to normal levels. Periods of stress can release **Lead** back into your systems.

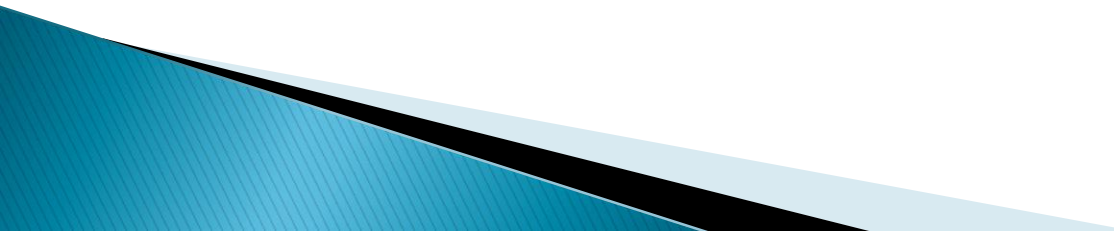
# How Lead interferes with tissues in our bodies

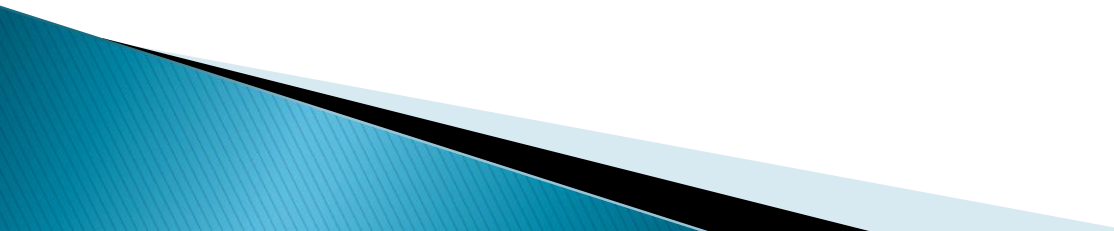
- ▶ **Lead** greatly disturbs multiple enzyme systems and mimics other metals that take part in biologic processes
    - Calcium, iron, zinc, phosphorus
    - Thus if nutritional deficiency...more susceptible to **Lead** toxicity
    - How? Binds to sulfhdryl groups, displacing the “mineral” which helps in the enzymatic reaction
- 



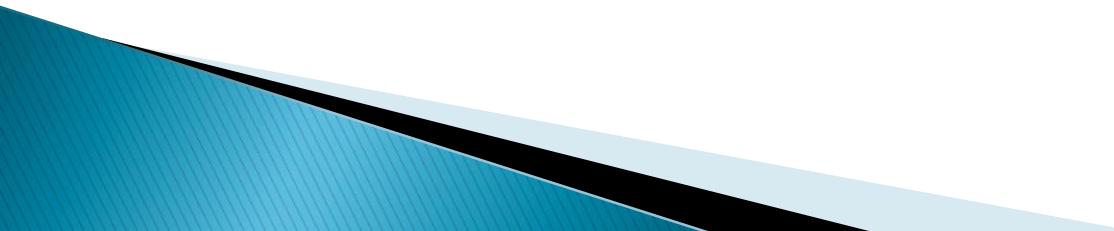
- ▶ When **Lead** is absorbed into the blood stream, **Lead** attaches itself to red blood cells and circulates throughout the body. The body recognizes **Lead** as being calcium and other good elements.
  - ▶ **99% of Lead in blood is bound to hemoglobin**
  - ▶ Heme is essential for all cells to get oxygen, and **Lead** impacts the production of Heme. Deficiencies in heme have far-reaching effects all across our bodies, especially reduction in oxygen transport to cells: anemia
  - ▶ ZPP (Zinc Protoporphyrin) testing helps determine this Heme affect
  - ▶ **Lead** infiltrates bones and teeth.
- 



- ▶ When **Lead** enters the brain, **Lead** interferes with neurotransmitters, a job that calcium is supposed to regulate. **Lead** alters permeability of blood brain barrier
  - ▶ There are many effects of **Lead** poisoning on the brain including
    - delayed or reversed development,
    - permanent learning disabilities,
    - seizures,
    - coma,
    - and even death.
  - ▶ Increased incidences of depression, aggressive behavior, and antisocial behavior may also be symptoms
- 

- ▶ **Lead** also resides in the kidneys. This can result in kidney damage, sometimes without any symptoms appearing at all.
  - ▶ **Lead** is primarily excreted in urine and bile, but the elimination rate varies, depending on the tissue that absorbed the **Lead**.
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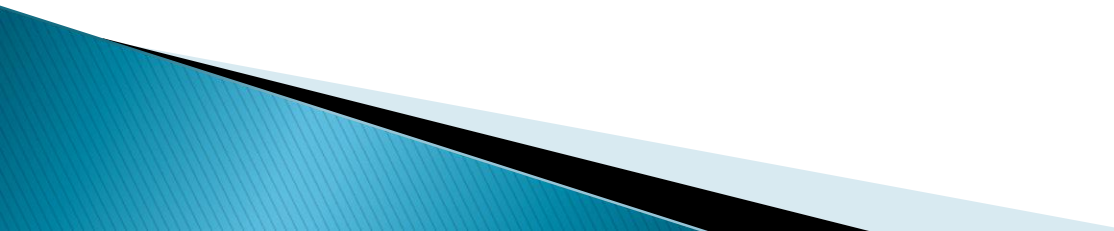
# Reproductive Toxicity of Lead

- ▶ **Males:** Blood Lead levels above 40 ug/dl impacted sperm count, motility, morphology
  - ▶ **Females:** Miscarriage, prematurity, low birth weight
  - ▶ **Lead passes through placenta to fetus; also into breast milk**
  - ▶ **Fetus:** Effects on developing fetus most apparent for exposures during **first trimester**... prevent **Lead** exposure as early as possible.
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# Path of Exposure

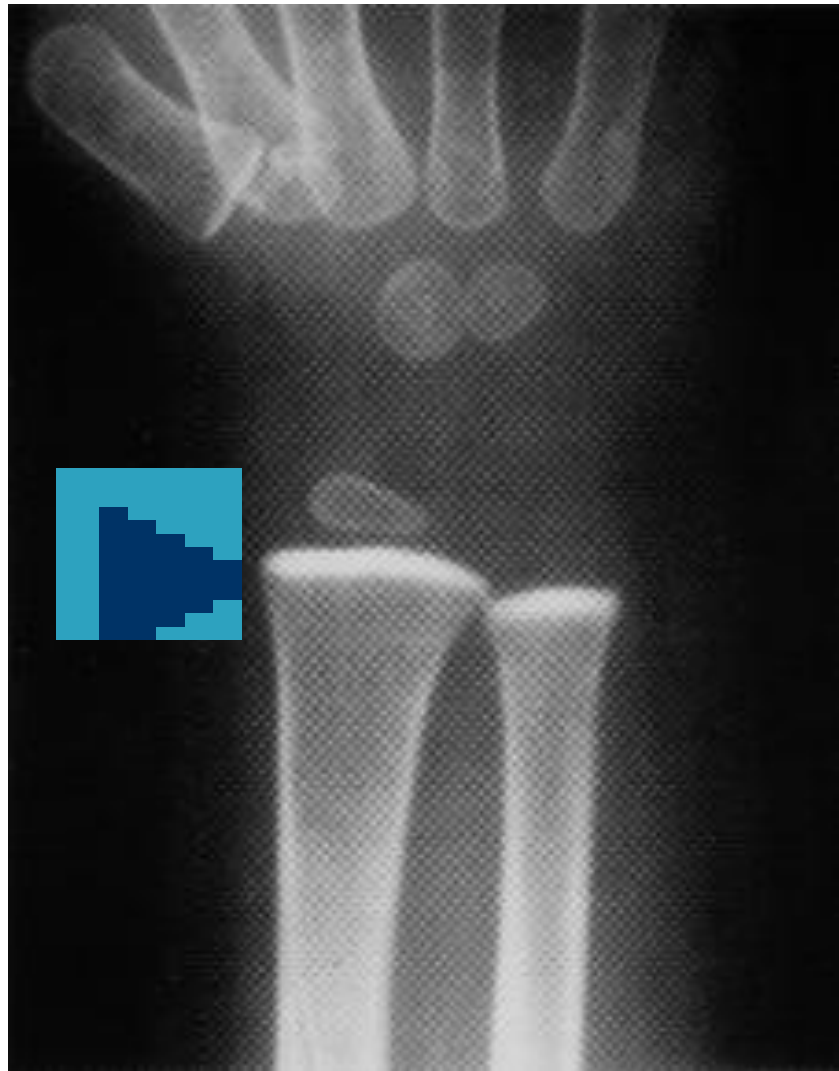
- ▶ Route of entry
  - Inorganic **Lead** ☞ respiration and ingestion
  - Organic (tetraethyl) ☞ skin
- ▶ Once absorbed, **Lead** is distributed to blood, soft tissues, and skeleton; excreted in urine mainly
- ▶ How/when does it come out?
  - Weeks for blood (half-life 30 days), months for soft tissues, years for bones (half-life 20–30 yrs)
  - Increased release from bone if more rapid turn-over, e.g., hyperthyroidism, pregnancy, breast feeding, menopause

# GOAL: Interrupt Lead getting into body

- Working with does not equal exposure
  - Work practices, e.g., keep temperature down below a specific temp to limit volatilization
  - Engineering Controls
  - Personal Protective Equipment
  - ▶ All work settings....
- 

# Why is PROTECTION so important?

- ▶ Contaminated clothing gets **Lead** dust in family cars or trucks, and family members get exposed.
- ▶ Infants, children, and pregnant women (unborn child) are threatened by even small amounts of **Lead** in their environment. **Lead** interferes with developing brains and other susceptible body parts.
- ▶ Children of **Lead**–exposed construction workers were six (6) times more likely to have blood **Lead** levels over the recommended limit.



**Lead poisoning in 4  
year-old boy. Abnormal  
calcification in the  
radius and ulna**

**What about YOU?**



# Typical Symptoms? It Depends...

- ▶ Main complaint could be non-specific (any body system)
  - Examples...age of worker, prior Lead exposure (bone stores), nutrition, genetics, concurrent disease processes, route of entry, duration of exposure, rapid or slow increase Lead level, type of Lead
- ▶ Early exposures, mild ☞ fatigue, headache, uneasy stomach, poor appetite, metallic taste, sleeplessness, irritability or nervousness, reproductive problems
- ▶ Later signs and symptoms, severe ☞ aches/pains in stomach, constipation, nausea, weight loss, memory problems, muscle and joint pains, weak wrists and ankles, kidney problems.

# Physiological effects of lead on adults and children

## Effects on adults

Brain disease  
Anemia  
Colic

Non-specific symptoms\*

Memory impairment

Sperm abnormalities

Kidney disease

Possible gout

Spontaneous abortion

Possible non-specific symptoms\*

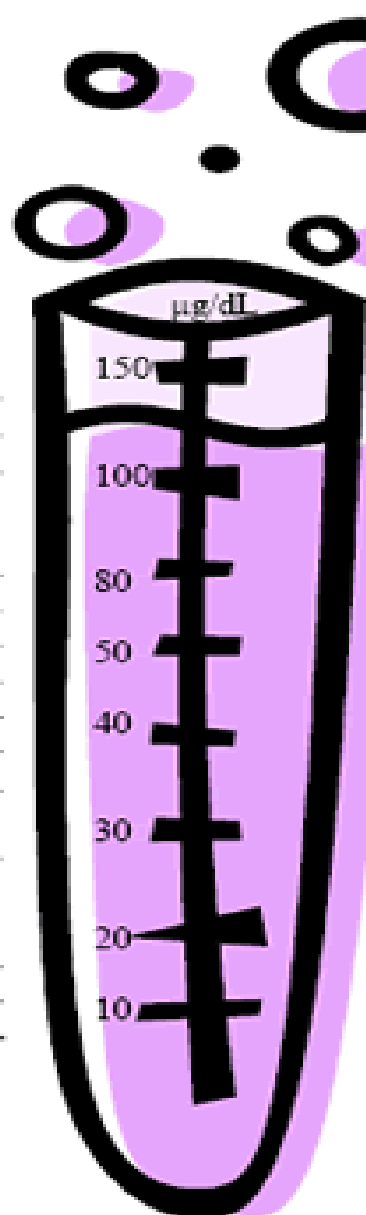
Possible memory impairment

Reduced birth weight

Hypertension and kidney dysfunction

Possible postnatal developmental delay

*\*Non-specific symptoms may include headache, fatigue, sleep disturbance, anorexia, constipation, joint pain, muscle pain, and decreased libido.*



## Effects on children

Death

Coma

Convulsions

Brain disease

Kidney disease

Frank anemia

Colic

OSHA removal level

OSHA blood lead testing

Decreased capacity to transport oxygen

Increased risk of hypertension in adulthood

Body can't maintain adequate calcium levels

Developmental toxicity

Decreased IQ level

Decreased hearing

Decreased growth

Impaired nerve function

Trans-placental transfer

Adapted from: *J Clin. Invest.* 116:853-857 (2006)

Data also obtained from: *Environ Health Perspect* 115:463-471 (2007) and

[www.atsdr.cdc.gov/csem/lead/pbphysiologic\\_effects2.html](http://www.atsdr.cdc.gov/csem/lead/pbphysiologic_effects2.html)

# Duration of Effects of Lead Poisoning

## ▶ Short-term

- Fatigue
- Headache
- Irritability
- Metallic taste
- Poor appetite
- Reproductive problems
- Sleeplessness
- Stomach upset

## ▶ Long-term

- Kidney problems
- Memory loss
- Muscle and joint pains
- Premature loss of teeth
- Shortened life span
- Stomach aches and pains, nausea
- Weak wrists and ankles

# Acknowledgement

- ▶ John W. Burress, MD, MPH, FACOEM
  - ▶ Clinical Director, Occupational and Environmental Medicine Department, BMC
- ▶ Rose H. Goldman, MD MPH
  - ▶ Chief, Occupational Environmental Medicine ~ Cambridge Health Alliance



# THE END

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**Lead In Construction**  
1926.62

# Construction tasks that generate Lead dust and fumes include:

- ▶ Using flame–torch cutting or welding or using heat guns on Lead painted surfaces during repair, reconstruction, dismantling, demolition, or abatement work
  - ▶ Abrasive blasting of bridges and other structures containing Lead–based paints
  - ▶ Sanding, scraping, or grinding Lead painted surfaces during repair, reconstruction, dismantling, demolition, or abatement work
  - ▶ Maintaining exhaust duct work
- 



# Dusts and Fumes

- ▶ Dust consists of small solid particles in the air. Dusts may be created when solids are pulverized, ground, crushed, drilled, abraded or blasted, or when powder (settled dust) becomes airborne.
  - Paint scraping
  - Buffing
  - etc

# Dusts and Fumes

- ▶ Fumes consists of very small, fine solid particles in the air which form when solid chemicals (often metals) are heated to very high temperatures, evaporate to vapor, and finally become solid again.
  - Welding
  - Torching
  - etc\



# OSHA Standard 29 CFR 1926.62

- ▶ Permissible exposure limit (PEL):
  - 50 micrograms per cubic meter of air ( $50\mu\text{g}/\text{m}^3$ ), measured as an 8-hour time-weighted average (TWA).
- ▶ Action Level (AL):
  - 30 micrograms per cubic meter of air ( $30\mu\text{g}/\text{m}^3$ ), measured as an 8-hour time-weighted average (TWA).

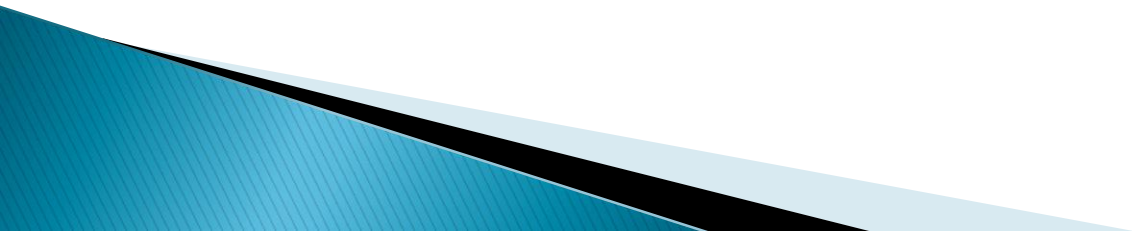
# Compliance Program

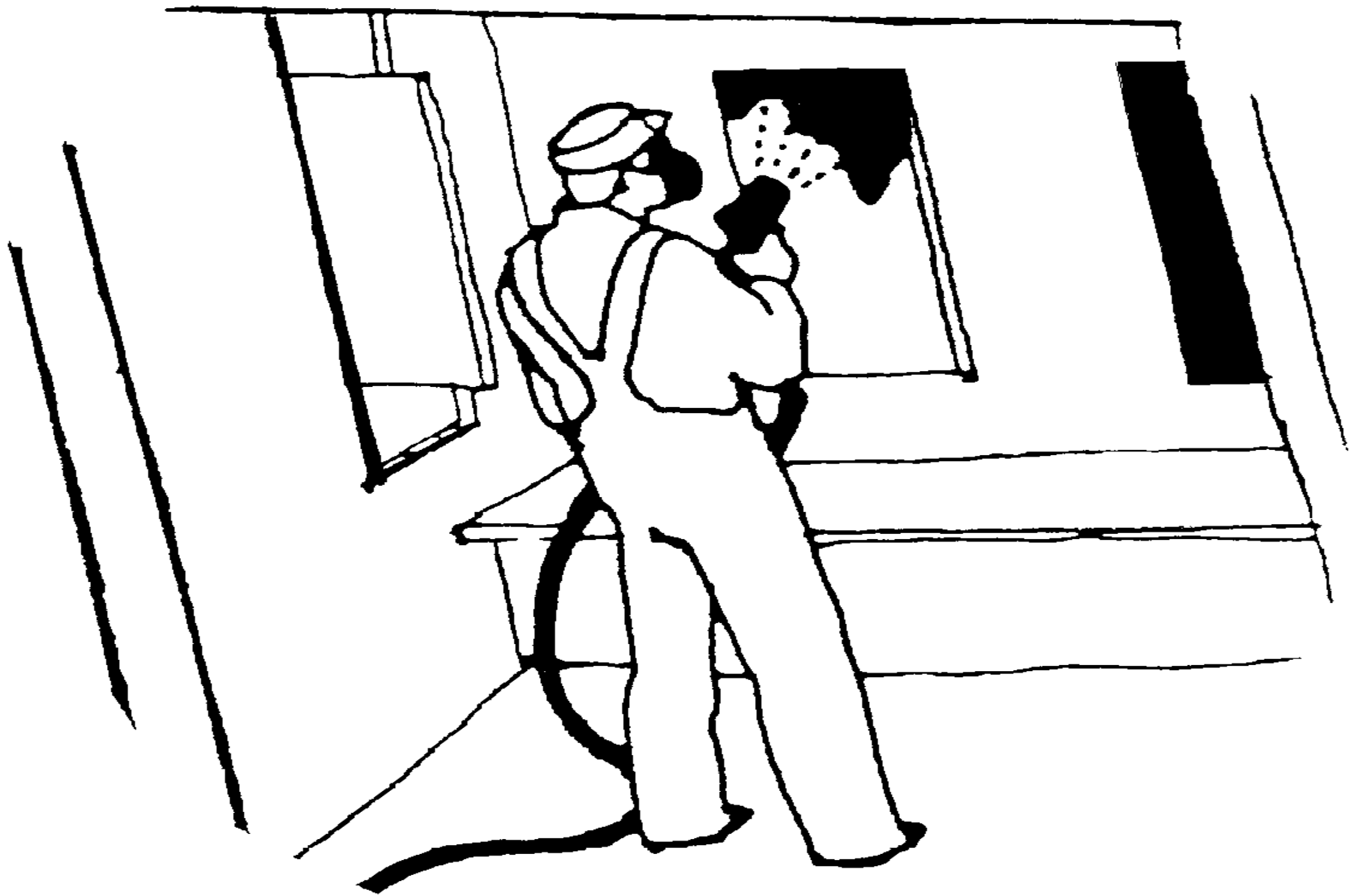
- ▶ Exposure Assessment
  - ▶ Respiratory protection
  - ▶ Housekeeping
  - ▶ Hygiene facilities
    - Change areas
    - Showers and handwashing facilities
    - Eating facilities
  - ▶ Medical Surveillance
  - ▶ Medical Removal
  - ▶ Training and Information
  - ▶ Signs
  - ▶ Recordkeeping
- 

# Exposures

- ▶ When the PEL is exceeded:
- ▶ Use the hierarchy of controls
  - 1. Feasible engineering and work practice controls to reduce ↓ PEL
  - 2. If still exceeding PEL, must supplement controls with appropriate respiratory protection.
  - 3. The employer also must ensure that employees wear the required respiratory protection provided.
- ▶ Try eliminating toxic chemicals by replacing harmful toxic materials with less hazardous ones

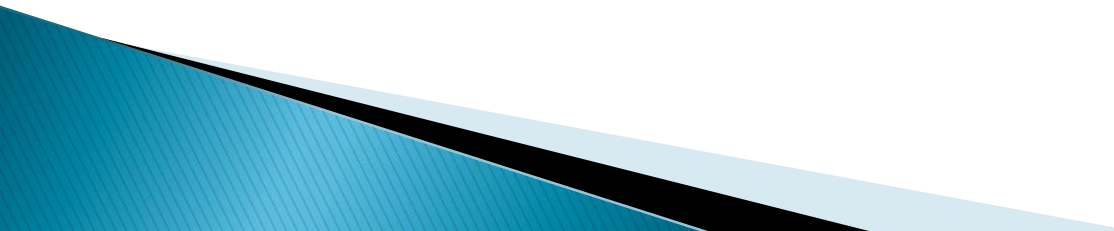
> 50 to 500  $\mu\text{g}/\text{m}^3$

- ▶ Manual demolition
  - ▶ Dry manual scraping
  - ▶ Dry manual sanding
  - ▶ Heat gun use
  - ▶ Power tool cleaning with dust collection systems
  - ▶ Spray painting with **Lead** paint
- 





> 500  $\mu\text{g}/\text{m}^3$  to 2,500  $\mu\text{g}/\text{m}^3$

- ▶ Using **Lead**-containing mortar
  - ▶ **Lead** burning
  - ▶ Rivet busting
  - ▶ Power tool cleaning without dust collection systems
  - ▶ Cleanup of dry expendable abrasive blasting jobs
  - ▶ Abrasive blasting enclosure movement and removal
- 



> 2,500  $\mu\text{g}/\text{m}^3$

- ▶ Abrasive blasting
- ▶ Welding
- ▶ Torch cutting
- ▶ Torch burning

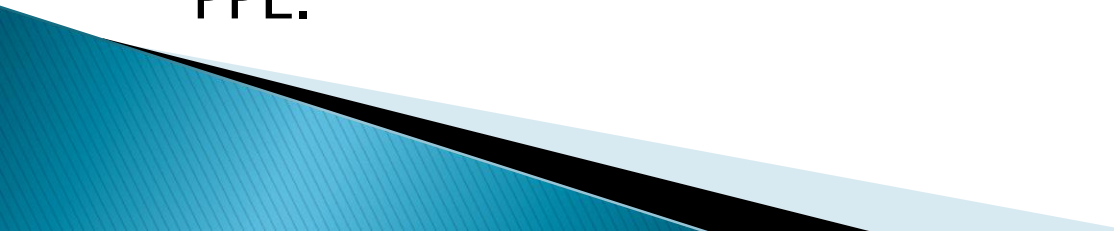


before

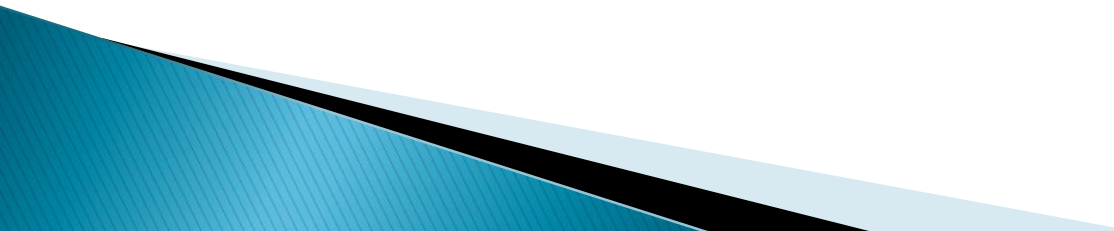


after

# Sampling

- ▶ When sampling for welding fumes, the filter cassette must be placed inside the welding helmet to obtain an accurate measurement of the employee's exposure.
  - ▶ NOTE: The practice of placing the sampling device inside personal protective equipment (PPE) applies only to PPE that is not intended to provide respiratory protection such as welding helmets or face shields. This sampling is performed to determine if respiratory protection is needed. If the PPE has supplied air, such as a welding hood or an abrasive blasting hood, then the sample is placed outside the PPE.
- 

# Examples of Engineering Controls

- ▶ Vacuum-blast cleaning;
  - ▶ Wet abrasive blast cleaning;
  - ▶ High-pressure water jetting;
  - ▶ High-pressure water jetting with abrasive injection;
  - ▶ Ultrahigh-pressure water jetting;
  - ▶ Sponge jetting;
  - ▶ Carbon-dioxide (dry-ice) blasting;
  - ▶ Chemical stripping; and
  - ▶ Power-tool cleaning
- 



Air-purifying Respirators

## Atmosphere-supplying Respirators







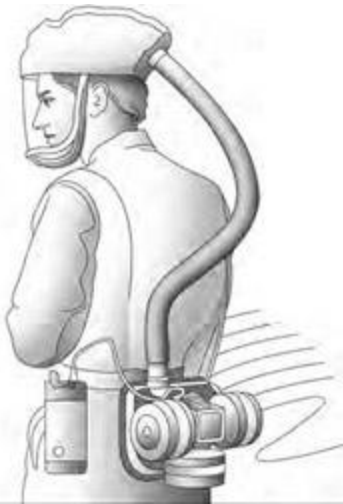
Half mask/Dust mask  
APF=10  
Needs to be fit tested



Half mask (Elastomeric)  
APF=10  
Needs to be fit tested



Full facepiece (Elastomeric)  
APF=50  
Needs to be fit tested



Loose-Fitting Powered  
Air-Purifying Respirator  
(PAPR)  
APF= 25



Hood Powered Air-Purifying  
Respirator (PAPR)  
APF= 25

***Air-purifying respirators,***  
which remove contaminants  
from the air.



Full Facepiece Supplied-Air Respirator (SAR)  
with an auxiliary Escape Bottle  
APF=1,000  
APF = 10,000 (if used in “escape” mode)  
Needs to be fit tested



Full Facepiece Abrasive Blasting  
Continuous Flow  
APF=1,000  
Needs to be fit tested



Full Facepiece Self Contained Breathing  
Apparatus (SCBA)  
Pressure demand mode is APF=10,000  
Needs to be fit tested

***Atmosphere supplying  
respirators***, which provide clean  
air from an uncontaminated  
source.

# For example:

Personal airborne exposures:  $600 \mu\text{g}/\text{m}^3$

Filtering facepiece APF 10

PEL:  $50 \mu\text{g}/\text{m}^3$

Are You Protected?

NO

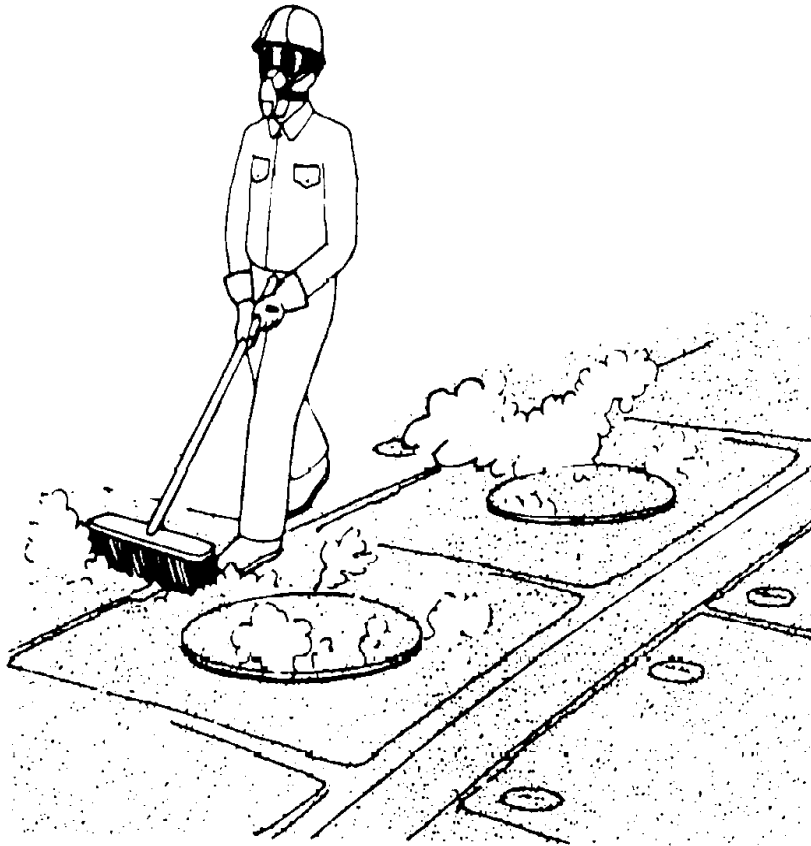
- ▶  $50 \times 10 = 500$  is the protection you are afforded up to
- ▶ You are at 600 so you need to jump up to the next level of protection



# PPE

- ▶ Full body protection of street clothes or clothes that can stay at work
- ▶ Protect feet/shoes, head, hands and skin
- ▶ Wash/Shower after work day

# Housekeeping



- ▶ Shoveling, dry or wet sweeping only allowed when HEPA vacuuming isn't feasible
- ▶ Never use compressed air

# Hygiene Facilities

- ▶ Change areas
  - The employer shall provide clean change areas for employees whose airborne exposure to **Lead** is above the PEL, and as interim protection for employees performing tasks as specified in paragraph (d)(2) of this section, without regard to the use of respirators.
- ▶ Showers and hand washing facilities
  - The employer shall provide shower facilities, where feasible, for use by employees whose airborne exposure to **Lead** is above the PEL.
  - The employer shall provide adequate hand washing facilities for use by employees exposed to **Lead**. (no need to be over the PEL)



# Hygiene Facilities (cont)

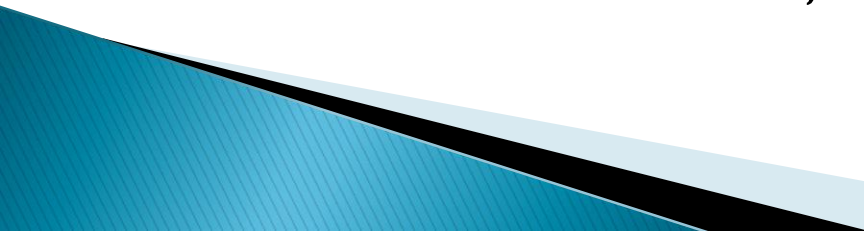
## ▶ Eating facilities

- The employer shall assure that in areas where employees are exposed to **Lead** above the PEL without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied.
- The employer shall assure that employees whose airborne exposure to **Lead** is above the PEL, without regard to the use of a respirator, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.



# Medical Surveillance

- ▶ Upon initial assignment in areas  $\geq$  AL > 30 days in consecutive 12 months
- ▶ Blood Leads and ZPP (Zinc protoporphyrin)
- ▶ Magic Number is  $\leq 40 \mu\text{g/dl}$
- ▶ At least every 2 months for the first 6 months and every 6 months after that
- ▶ If  $\geq 40 \mu\text{g/dl}$ , then every 2 months until BLL  $\downarrow 40 \mu\text{g/dl}$ .
- ▶ Construction standard (1993) does not fully protect workers: allowable blood lead levels are too high (up to  $40\mu\text{g/dL}$ ) and monitoring every 2 months may not be frequent enough
- ▶ Keep blood lead levels below  $20\mu\text{g/dl}$  (and ideally below  $10\mu\text{g/dl}$ ) for long term exposures

- ▶ ZPP levels greater than 35 micrograms per deciliter ( $\mu\text{g}/\text{dL}$ ) indicate lead-induced heme inhibition and serve as a means of determining the internal toxic effect of lead absorption.
  - ▶ The lag in ZPP elevation and decline compared to blood lead levels makes ZPP measurements useful for distinguishing between acute and chronic lead intoxication and may help to determine whether a mid-range blood lead level is likely to reflect prior higher-level exposure.
  - ▶ At the blood lead levels currently permitted under the OSHA Lead standard, the ZPP test is a useful adjunct.
- 

# Medical Removal

- ▶ Blood Leads:  $\geq 50 \mu\text{g}/\text{dl}$ 
  - Two consecutive blood tests
- ▶ Final medical determination
- ▶ Return to Work
  - Two consecutive blood tests  $\leq 40 \mu\text{g}/\text{dl}$ ; or
  - Written medical opinion permits the return
- ▶ Medical Removal Protection Benefits
  - Up to 18 months on each occasion of removal
  - i.e. total normal earnings and status until job complete

# Management Issues

- ▶ Medical Removal Protection at 50 mcg/dl
  - stipulates salary protection and that workers can be removed at lower levels if treating clinician believes that elevated **Lead** level responsible for adverse health effects
    - Annual Med Eval for BLL above 40 mcg/dl
- ▶ Research ongoing on cumulative effects of long-term exposure (over a working life)
  - Ideally **Lead** level low as possible but what are the consequences of 10–20 mcg/dl and above for yrs?
  - Known economic ( ↓\$) versus unclear health consequence

# Training

- ▶ Hazcomm information
    - MSDS, labels, emergency provisions, PPE
  - ▶ Initially and annually
  - ▶ Standard and Apps
  - ▶ Operations creating exposures
  - ▶ PPE
  - ▶ Medical Surveillance
  - ▶ Medical Removal
  - ▶ Engineering Controls
  - ▶ Work Practices
  - ▶ Compliance Program
  - ▶ Rights to Access
    - Medical records
    - Air monitoring
    - Standard and apps
  - ▶ Signs
- 

# Signs

- ▶ In areas > PEL
  - Warning
  - **Lead Work Area**
  - Poison
  - No Smoking or Eating

# Remember – airborne driven standard

If not above PEL/AL, you do not fall under the OSHA Lead Standard **BUT** you still must provide:

- ▶ HazComm training
- ▶ Wash facilities
- ▶ Housekeeping



# THE END

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